

A micro-Raman archaeometric approach to Roman wall paintings

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Abstract

Infrared and Raman spectra have been recorded on the surface of plasters from *Regium Lepidi* (Reggio Emilia, Italy). A palette has been identified, that can be compared with the ones from the nearby towns of the Roman Empire, but some peculiarities can be outlined. Some of the pigments could come from the territory, even though the techniques could be ascribed to those usually present in the 1st century A.C.

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1. Introduction

There is a general interest in the study of ancient plasters coming from *domus* of the Roman age in Italy. In fact, whereas many studies have been carried out from the archaeological and artistic point of view, little has been investigated on the materials and techniques employed for obtaining the mural paintings [1–5]. A comparison of the pigments found and the particular techniques used in different area could help in tracing the possible routes of their origin and diffusion and supply a detailed description of the craftsmen ability, their knowledge and material sources. So, an investigation has been undertaken on some plasters coming from different sites of the Roman province of *Regium Lepidi* (now Reggio Emilia) in the *VIII Regio*, Northern Italy. The samples from *Regium* Archaeological Museum are all coming from recent excavations already described [6,7]. The fragments come from three areas, two situated in the middletown of Reggio Emilia, one in the centuriated territory, north of the town.

Concerning the first site, the plasters found in the crossroad between via Mazzini and via Cairoli (MC) pertain to a *domus* and were placed inside archaeological layers rich in ceramic and glass material of the first imperial age. The second urban site (Credito Emiliano) (CR) is in the central area of the Roman

town and has given plasters in a very interesting stratigraphic sequence; the fragments come from layers relative to an Augustean phase, where the structures found are part of private buildings with mosaic and *coccio pesto* floors.

The third group comes from an area situated in the village of Poviglio (Le Grazie) (PO) that in the Roman age corresponded to the centuriated zone of the colony of *Brixellum* (now Brescello); this case is an important rural settlement, with the residential sector provided with mosaic and *coccio pesto* floors, whose greatest expansion can be ascribed to the first imperial age.

This work is part of a wider project, aiming to study the pigments, the technical and pictorial techniques in the Italy of the 1st century A.C. The corresponding data relative to the plasters of the province of Modena have been completed and accepted for publication [8].

2. Experimental

A protocol has been set up and applied, establishing how to order and in what way to collect the samples, record the Raman and IR spectra, prepare the cross sections, analyze them by different techniques, and so on. It included both non destructive and destructive methods, applied to the original painted surface and to cross sections. The present investigation is limited to the painted surface and is carried out only with IR spectroscopy and Raman microscopy.

Samples, of about 2 mg, were taken from the differently pigmented areas of the plasters. The infrared spectra were

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Fig. 1. Some samples from *Regium* CM 1000, CM 1001.

recorded on the samples in the form of KBr pellets at a concentration of 1%. For the recording of IR spectra in transmittance a Perkin-Elmer 1700 spectrometer in the range $4000\text{--}400\text{ cm}^{-1}$ has been utilised. The spectra were recorded in a controlled atmosphere so as to eliminate as far as possible the infrared bands of carbon dioxide and water vapour. From the spectra the nature of the pigments and accessory components was identified by comparing them with databases, articles and source books [10–14].

The Raman spectra were obtained with a confocal Jobin Yvon Labram Raman microscope, by employing the 632.8 nm line and a power of about 1 mW. The detector was a CCD (330×1100) with 1100 pixels cooled by Peltier effect. The spectral range varied, but in all cases was extended down to 100 cm^{-1} . The spectra were recorded without any preparation of the samples, the latter being only laid on a metal support. After focalisation of a crystal through a microscope and a CCD camera, the spectrum was recorded with a variable number of scans or time of accumulation, according to the intrinsic signal intensity. When necessary, X-ray diffractometry—XRD was recorded by Panalytical X-pert instrument, having Cu $K\alpha$

incident radiation and Ni filter, at 40 kV and 40 mA, directly on the sample surfaces, and collecting the diffracted data by an X Celerator detector.

For comparison purpose, the infrared and Raman spectra of many commercial pigments or minerals have been recorded, too. All these spectra have been inserted in a database of historically attested pigments now available in the Raman Laboratory of the Chemistry Department of Bologna University, as a part of the research carried out on financial support by Italian CNR (National Research Council) in collaboration with the University of Modena and Reggio Emilia.

3. Results and discussion

Some of the analyzed samples are reported in Figs. 1–4. It can be seen a nice polychromic aspect, with a clear blue in the first sample covering a great part of its surface. The second one has trace of decorations with white, green, yellow, brown and with many overlapped layers and curved lines describing a motif, partly lost. The subsequent samples exhibit a series of straight lines with white or darker colors separating different areas.



Fig. 2. Some samples from *Regium* CM 1002, CM 1003.

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